# METHOD OF MAKING TOOL PATH

## BACKGROUND OF THE INVENTION

[0001] This application claims the benefit of Japanese Application Number 2001-130129 filed Apr. 26, 2001, the entirety of which is incorporated herein by reference.

[0002] 1. Field of the Invention

[0003] This invention relates to a method of making a tool path by using a CAM in a machine tool.

[0004] 2. Description of the Related Art

[0005] A method of making a tool path shown in **FIG. 7** has heretofore been known. In a step **S51**, two-dimensional and three-dimensional shapes to which a work is to be processed are inputted. In a step **S52**, processing conditions, such as a tool shape and processing methods are inputted. The processing methods include the contour line processing and the scanning line processing. In a step **S53**, a processing region (i.e. region to be processed) is designated on a surface to be processed with the shape to which the work is to be processed and processing conditions taken into consideration. In a step **S54**, reference lines are designated on the processing region. In a step **S55**, a tool path in the processing region is computed on the basis of the input information and reference lines. In a step **S56**, the data on the tool path are outputted.

[0006] When such a processing region as is shown in **FIG. 8** is designated, reference lines are usually designated at both edges of the processing region. As shown in **FIG. 9**, when the reference lines are straight lines, a tool path is a straight line parallel to the reference lines, and computed plurally in the direction (which will hereinafter be referred to as picking direction) which is perpendicular to the reference lines. When the reference lines are curves, the tool path is a curve obtained by gradually increasing the curvature of the reference lines, and computed plurally in the picking direction which is at right angles to tangents of the reference lines as shown in **FIG. 10**.

[0007] When a work is processed by using the data on a tool path made by a related art method of this kind, a difference in level of a processed surface occurs at a starting end or a terminal end of a processing region. For example, when a cylindrical surface to be processed is divided into a plurality of parts, which are then processed by scanning lines (moving a tool in parallel with the Y-axis) as shown in **FIG. 11**, differences in level remain in boundary portions of processing regions **1**, **2**, **3**. The causes of the occurrence of such differences in level include the wear on the tool, thermal expansion of the tool or work, and a correction error of a tool length which occurs while the regions are processed. When a flat surface to be processed is divided into parts, differences in level also remain in boundary portions of a processing region, in the same manner as in a case where a curved surface is processed.

## SUMMARY OF THE INVENTION

[0008] The present invention has been made in view of these circumstances, and provides a method of making a tool path, capable of making inconspicuous the differences in level of boundary portions of processed regions, and obtaining a smooth processed surface.

[0009] A first aspect of the invention provides a method of making a tool path, including the steps of designating processing regions on a surface to be processed, designating reference lines on the processing regions, calculating on the basis of the reference lines a plurality of tool paths on the processing regions, selecting at least one of the adding of a tool approaching expansion region of which a distance measured from the surface to be processed) becomes larger as the expansion region gets away from the processing region to a starting end in the picking direction of the processing region, or the adding of a tool escaping expansion region of which a distance measured from the surface to be processed becomes larger as this expansion region gets away from the processing region to a terminal end in the picking direction of the processing region, and calculating the tool path within the expansion region.

[0010] A second aspect of the invention also provides a method of making a tool path, including the steps of dividing a surface to be processed into parts and designating a plurality of processing regions, designating reference lines on the processing regions, calculating on the basis of the reference lines a plurality of tool paths in each of the processing regions, adding a tool approaching expansion region of which a distance measured from the surface to be processed becomes larger as the expansion region gets away from the processing region to a starting end in the picking direction of a processing region which agrees with a boundary line of two adjacent processing regions, adding a tool escaping expansion region of which a distance measured from the surface to be processed becomes larger as this expansion region gets away from the processing region to a terminal end in the picking direction of the processing region which agrees with a boundary line of two adjacent processing regions, and calculating tool paths in each expansion region.

[0011] A third aspect of the invention further provides a method of making a tool path in accordance with the first or second aspect invention above, in which the expansion regions are tangential curved surfaces including boundary lines between the expansion regions and the processing region and contacting the surface to be processed, the radius of the tangential curved surfaces being set not smaller than an expansion amount of the tangential curved surfaces.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a flow chart of a method of making a tool path, showing a mode of embodiment of the present invention;

[0013] **FIG. 2** is a schematic diagram showing an example of the making of a tool path by the method of **FIG. 1**;

[0014] **FIG. 3** is a schematic diagram showing another example of the making of a tool path by the method of **FIG. 1**;

[0015] **FIG. 4** is a schematic diagram showing still another example of the making of a tool path by the method of **FIG. 1**;

[0016] **FIG. 5** is a schematic diagram showing the tool path of **FIG. 4**;

[0017] **FIG. 6** is a schematic diagram illustrating a method of calculating a tool path in an expanded region;